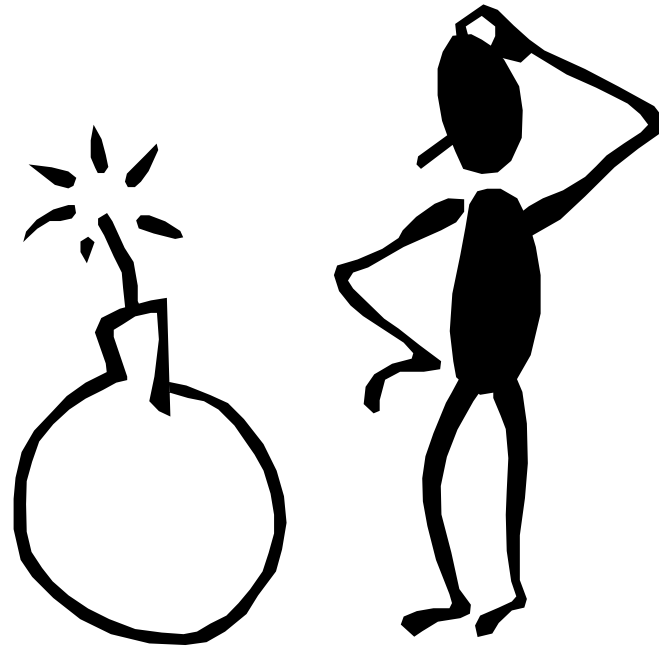


The Role of the Universities and CANTEACH in Succession Planning

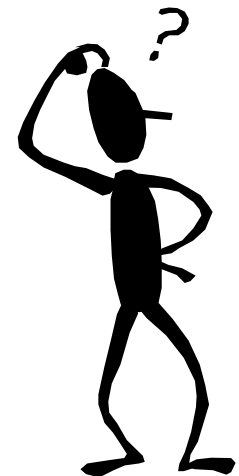
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prepared for presentation at the plenary session on Maintaining Vital Capability in the Canadian Nuclear Industry-Challenges and Opportunities, 22nd Annual CNS Conference, 2001.06.10-13.

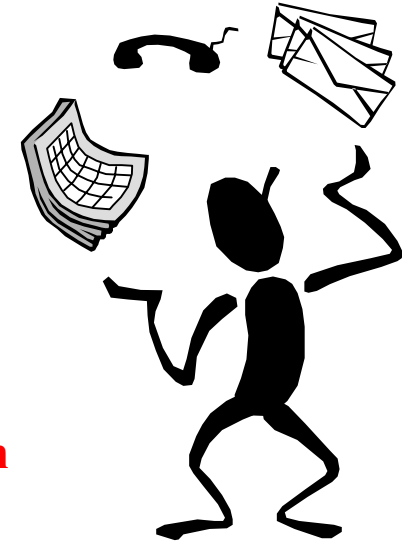
Overview

- The Issues
- Mandate and activities of the CNS Universities Committee
- Our view of the Canadian nuclear enterprise
- Accreditation and University Standards
- The status of Nuclear Engineering programs
- CANTEACH progress
- Steps forward
- Final message



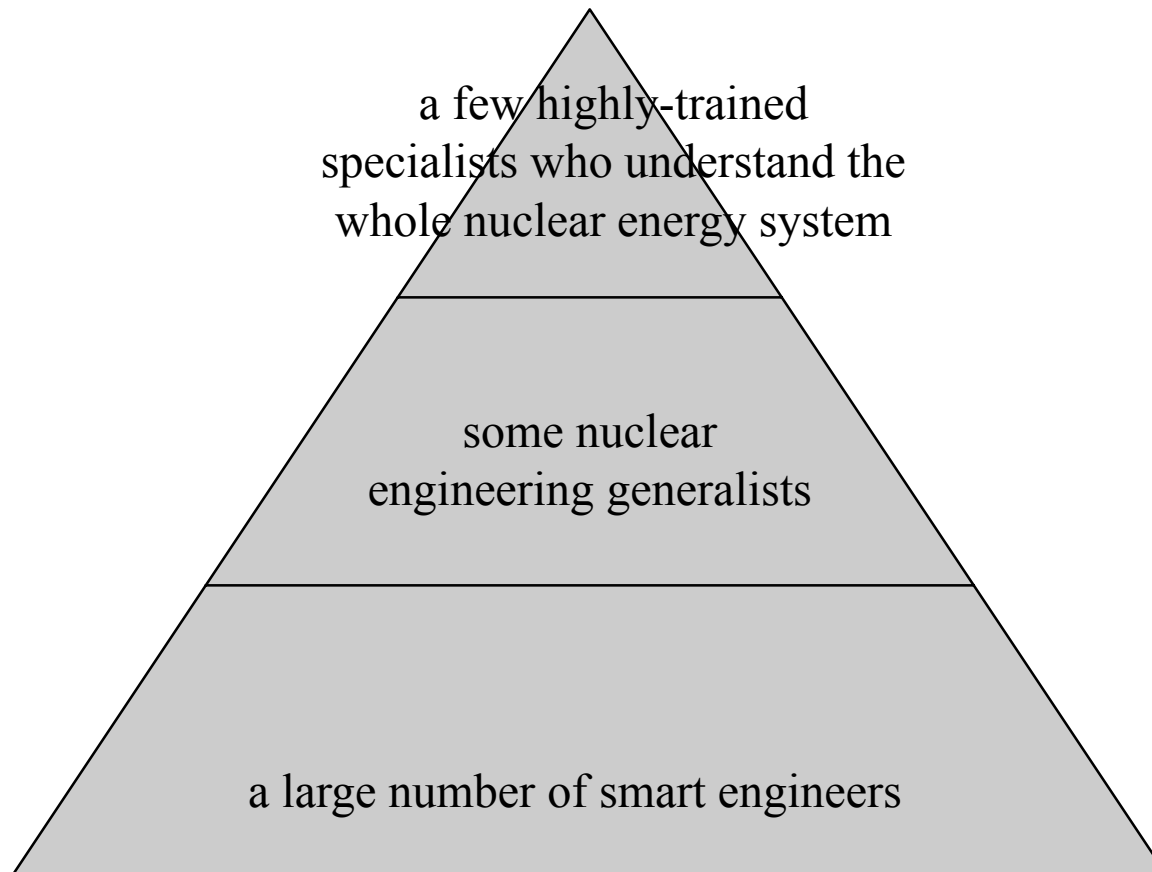
- **The Issues**

- Succession planning
 - education
 - training
 - certification
 - 'why'
 - the process vs. the product
 - precisely what does industry need? ◀ **key question**
- Client education and training
 - material
 - delivery
- Survival of Nuclear Engineering Educational Programs
 - reactor physics
 - nuclear systems
 - reactor safety
 - nuclear materials
 - applications of radioisotopes (nuclear medicine, instrumentation, ...)
 - ...



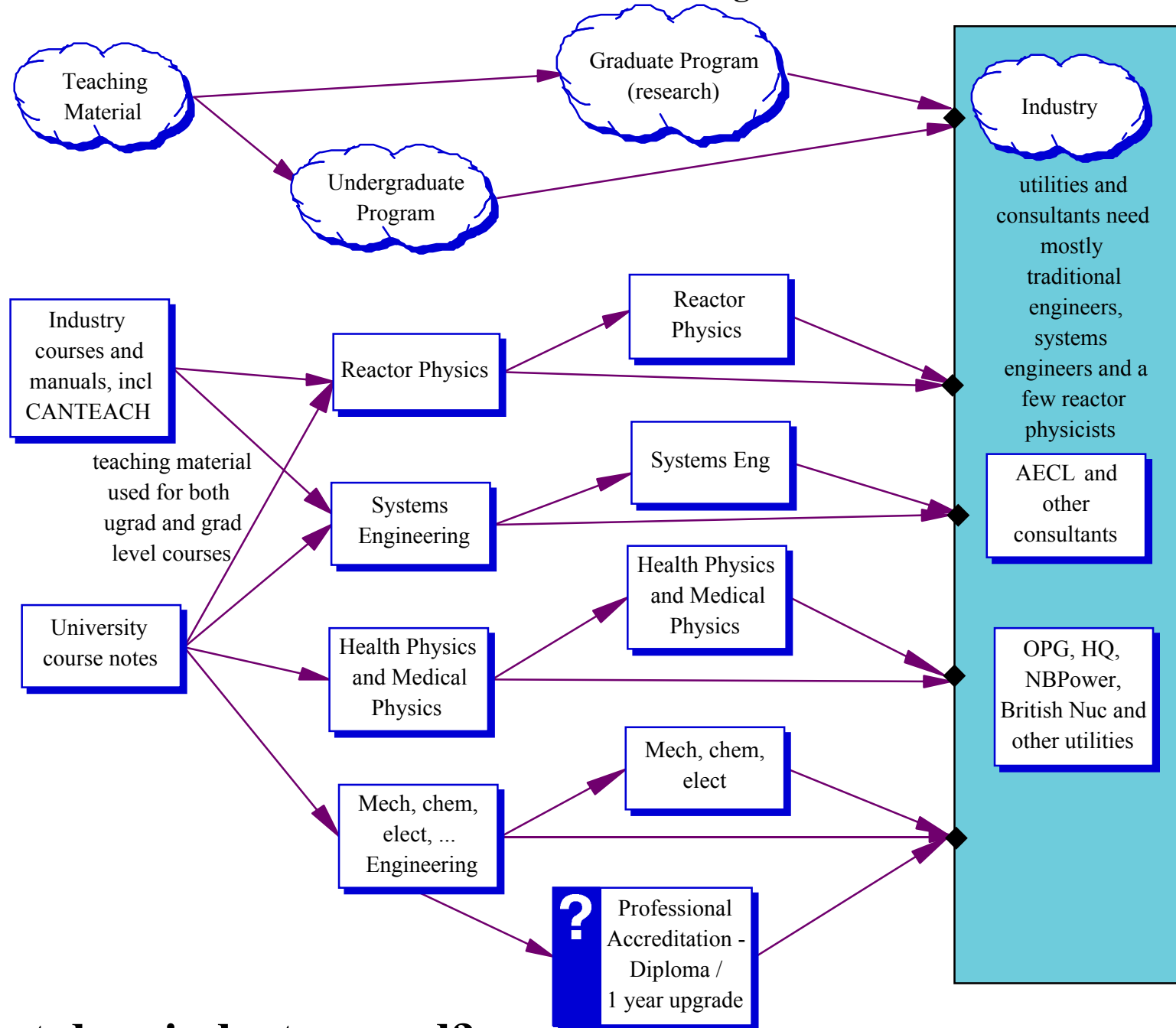
- **Succession Plan Vision**

- Intellectual Capital is industry's greatest asset. Thus we need to educate:



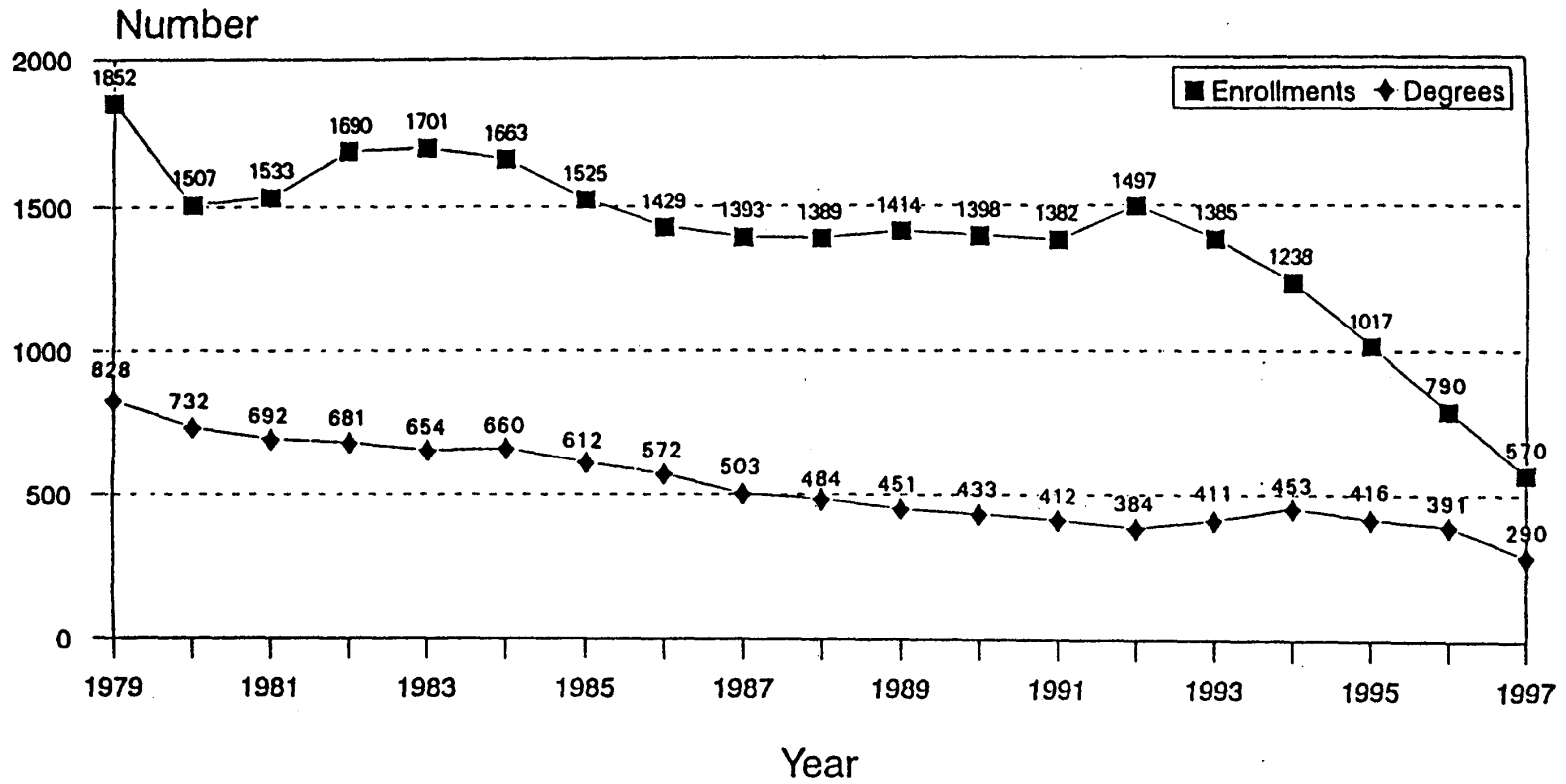
- The need for design 'know how' is just as great in an operational support mode as it is in a design mode.

Nuclear Education Program



• **What does industry need?**

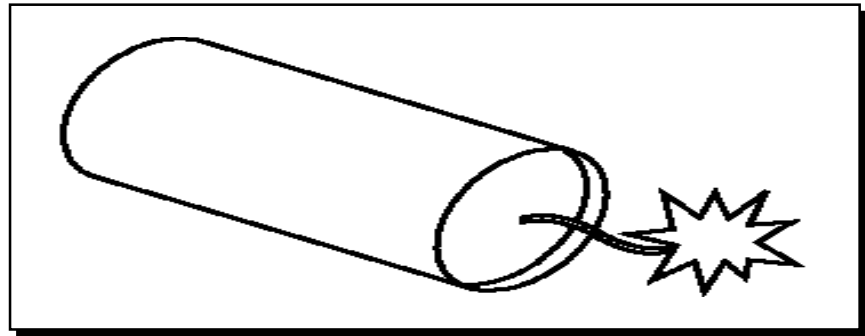
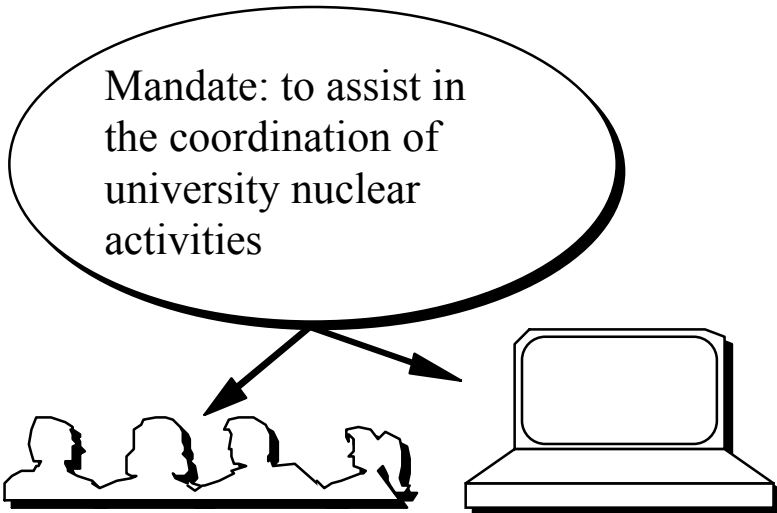
Survival of the Nuclear Engineering Education Programs



Nuclear engineering undergraduate (junior- and senior-level) enrollments and degrees, 1979–1997
 (Source: U.S. Department of Energy)

- **Mandate and activities of the CNS Universities Committee**
 - url: <http://epic.mcmaster.ca/~garlandw/univcomm/ucindex.htm>
 - The Universities Committee has the mandate to **assist in the coordination** of the activities of Canadian universities with nuclear programs in keeping with the CNS objective of acting as a forum for the **exchange of information** relating to nuclear technology among specialists and members of national and international scientific and learned societies.

Universities Committee



The Issue: low enrollment / expertise gap

- need to attract students
- need to make best use of existing expertise (university and industry)
- need to collaborate and share course material and teaching

University - industry collaborations:

- outreach to students,
- student support,
- research,
- teaching

Sharing of course material:

- distance learning
- reciprocal agreements
- sharing course material
- vision statements
- course outlines
- reference material
- diploma / degrees
- CD-ROM

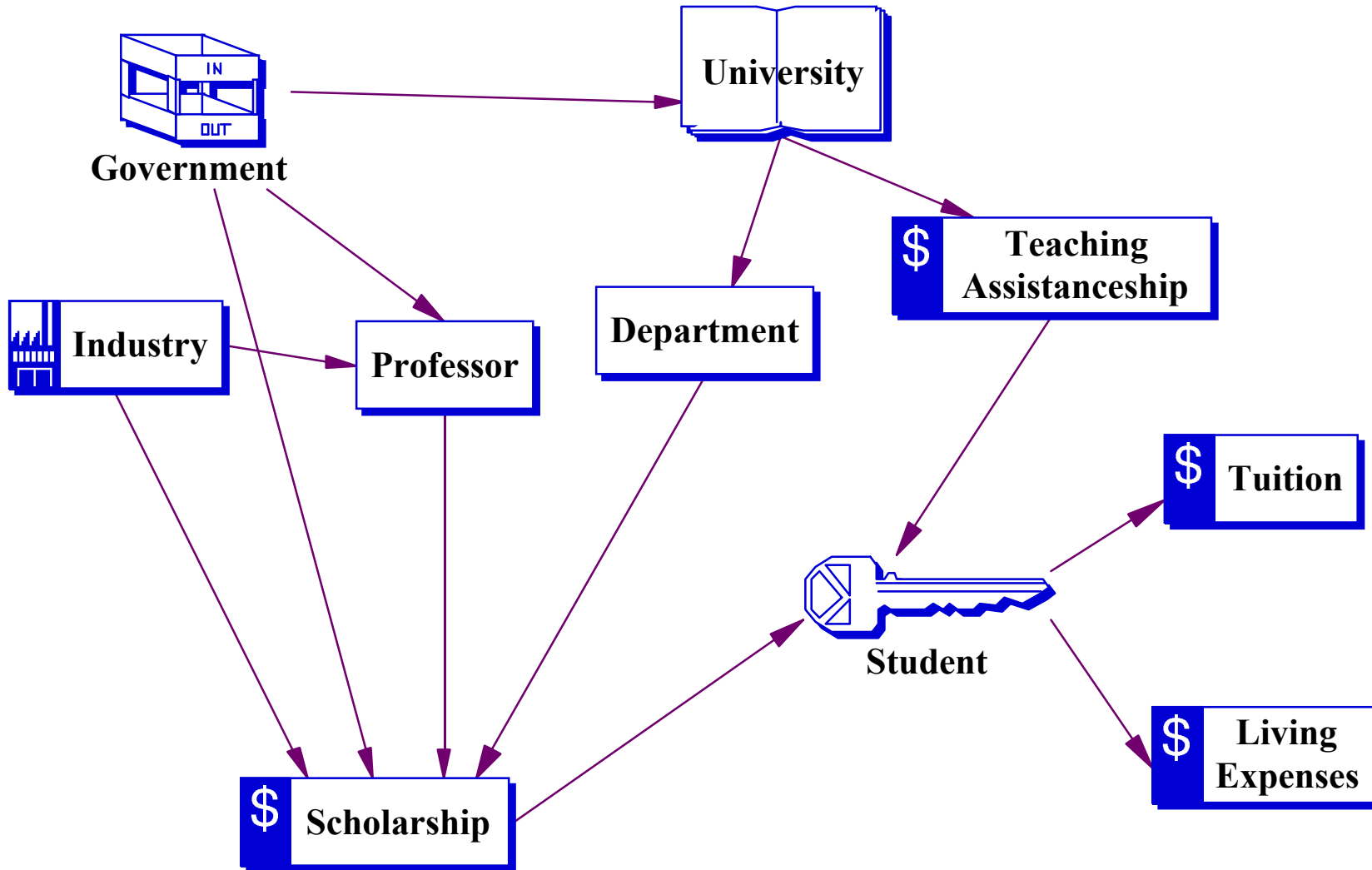
● Our view of the Canadian nuclear enterprise

- Credo: We are in the business of education so we can provide the baseline of training of fundamentals for the nuclear industry. The universities, really, are part of the infrastructure for industrial technology.
- More and more we fail to attract quality students in sufficiently large numbers as nuclear engineering is perceived as a moribund field.
 - We absolutely need to initiate a turnaround for this situation, and we don't see how this can be done without obvious and well publicized support from the nuclear industry. **Presence is most needed at an undergraduate level.**
 - Industry has to make some commitments to long-term education by providing student scholarships and supporting university applied R&D. **Why should a professor do applied R&D in the nuclear area? Why should students enter the field?**
- The vast majority of recent young hires have had little or no exposure to nuclear training or even occasional nuclear courses. For the sake of the quality of work in the future, we need to have a workforce that understands the technology in which it is working!
- It is very important to expand our education of people in other countries in CANDU technology.

• Accreditation and University Standards

- All Canadian undergraduate university engineering programs are accredited by the Canadian Engineering Accreditation Board (CEAB). The professional associations, such as the PEO, work through this board.
- Graduate programs are also accredited (such as in Ontario by the Ontario Council of Graduate Studies). Nuclear Science and Engineering graduate programs are included in those programs subjected to accreditation.
- University and professional requirements dictate that standards be met and be shown to be met. The standards are biased towards education, not training. The focus is on basic concepts, not specific instances.
- Certification occurs through the university and college programs.
- It would be very difficult, time consuming and very expensive to duplicate this process within the industry.
- The wiser route would be to support existing programs and to be involved in the modification / enhancement of existing programs to better suit the needs of the nuclear industry.

- **The financial game**



Who funds the student and the professor if neither industry nor government does?

- **The status of Nuclear Engineering programs in Canadian universities**
 - Who's who - visit the McMaster Nuclear Engineering web site at <http://epic.mcmaster.ca/~garlandw/> and go to the Who's Who page.
 - AECL has prepared a brochure (see copy) on the nuclear programs in Canadian universities as a beginning in setting up a network of centres of excellence.
 - this was done a few years ago
 - there has been no follow-up.
 - The universities that have nuclear engineering options and conduct nuclear related research are McMaster, RMC, École Polytechnique and UNB.
 - Other universities that have related expertise or otherwise can contribute include Toronto, Carleton, Manitoba, Queen's and Waterloo.
 - Collectively we'd make a great nuclear department.

- **Royal Military College:**

- Has an undergraduate program in Chemical Engineering and a graduate program (M.Eng., M.Sc. and Ph.D.) in Nuclear Engineering, supported by a SLOWPOKE-2 nuclear reactor.
- While undergraduate programs are restricted to military personnel, graduate programs are accessible to both military and civilian students.
- Research and education is conducted in the areas of reactor physics and simulation, nuclear fuel management and engineering, emergency response (equipment and dispersion analysis), regulations, radiation and health physics, fission product release, effects of radiation on materials, radioactive waste management, instrumentation and neural networks.
- In addition to the primary mission of supporting the Canadian Forces, the nuclear engineering program is also involved in civilian activities, such as radiation dose evaluation for high flying aircrews and astronauts (Transport Canada, Canadian Space Agency, NASA, commercial airlines), and CANDU reactor R & D (fission product release, advanced fuel cycles for CANDU's, CANDU fuel bundle optimal design), among many others.

- **École Polytechnique:**

- The IGN (Institut de génie nucléaire) only has a graduate program in Nuclear Engineering.
- It relies heavily on the Hydro-Québec Chair in Nuclear Engineering held by Daniel Rozon .
- Historically, the Institute was an autonomous unit but it joined the Department of Mechanical Engineering in about 1995. It is now part of the Engineering Physics department.
- Research is mainly oriented towards the power sector and the bulk of the research is in reactor physics (the DRAGON and DONJON codes), thermalhydraulics (ASSERT and multi-channel analysis).
- The IGN also has a SLOWPOKE reactor which is used teaching and research (neutron activation analysis)
- In short, École has established and maintained a strong link on the research side with HQ, AECL and COG.
- Who's who (visit the IGN web site at <http://www2.polymtl.ca/nucl/>)

- **University of New Brunswick:**

- The university has extensive ties to NB Power and the Centre for Nuclear Energy Research (CNER).
- The CNER Chair is held by Frank Stewart, the Nuclear Engineering Chair is held by Derick Lister (steam generator chemistry) and the Power Plant Chair is held by Robin Chaplin.
- The students can take a 16 month work term at Pt. Lepreau and can take a two week intensive Practical School at the plant.
- UNB has been working closely with NB Power, OH, and HQ to develop and present an extensive set of nuclear training material.
- The nuclear program at UNB have set up and maintained aggressive links to CNER and the utilities. The focus is operations and training.

- **Toronto:**

- Their Centre for Nuclear Engineering is dormant pending renewed industry.
- Their SLOWPOKE has been decommissioned because the resources were not available to refuel.
- Maintaining a Nuclear Engineering program is no longer considered a priority because of a lack of student interest and obvious career prospects.

- **McMaster University:**

- Each of the above four universities with a nuclear program has established a unique link to industry.
- The industrial / government partners are the key to the nuclear programs at all the other universities.
- McMaster has traditionally been aloof although individual professors have had specific contracts with industry.
- The obvious industrial partners are AECL design office at Sheridan Park, Bruce Power and OPG.
- We have a 5MW swimming pool reactor (see brochure)
 - great trainer
 - switch to MAPLE fuel?
 - use of AECL codes for analysis / bench marking
- Programs (see brochures)
 - Nuclear Engineering
 - Health Physics and Medical Physics

- **The Nuclear Diploma Program (McMaster University)**

- The Department of Engineering Physics at McMaster University offers a Graduate Diploma Program in Nuclear Technology - see <http://engphys.mcmaster.ca/graduate/diploma.htm> for details.
- This diploma program provides an overview of the fundamentals in
 - nuclear systems
 - nuclear reactor physics
 - reactor thermalhydraulics
 - reactor safety
 - nuclear instrumentation
 - nuclear environmental quality
 - fusion engineering
- These topics are important for
 - nuclear power plant design
 - operation
 - safety analysis
 - industrial applications of nuclear techniques.
- The program is a McMaster University program, will be managed by the university and is subject to the university's rules and regulations

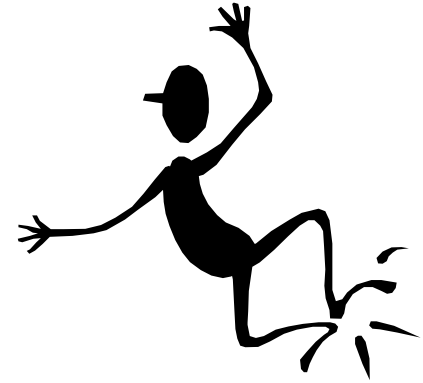
- The program is regulated by the School of Graduate Studies
- The program is run on a cost recovery basis with a break-even enrolment of 6 students per course.
- The courses are regular graduate level courses.
- Currently having difficulty attracting a sufficient number of students.
- Six students attended the first course; several students failed to meet the passing grade of B-.

- **CANTEACH progress**

- CANTEACH is intended to collect comprehensive documentation.
- Web site established at <http://epic.mcmaster.ca/canteach> (or see [handout](#)).
- Framework for the assimilation and production of material has been established
 - standard office application software (MS Word, Word Perfect, Visio, etc.)
 - delivery format is to be Adobe Acrobat pdf with a web based front end.
 - delivery mechanisms will be standard print, the web and CD-ROM.
- Focus will be initially on content preparation for 'why' CANDU is the way it is, rather than on more design descriptions.
- The plan is to prepare digestible, reusable 'lectures'. Do it once, do it well, and move on. Stop reinventing the wheel.
- Current 'workers' are Dan Meneley and Bill Garland. Hugues Bonin, RMC, will be on board 2001.07.01 for one year to work on reactor physics and fuel management.
- Writers to come from universities and industry.

- **Steps forward**

- Do things that latch
- Do things that have the best bang per buck
- Get industry involved in
 - inform High School students of career possibilities within the nuclear industry, with description of these careers and requirements in terms of academic degrees.
 - promotion - students must believe that the industry will exist in the future and is an exciting career choice
 - student hires
 - scholarships support (AECL and OPG have started to move here - Bravo!)
 - support of industrial chairs (perhaps shared by several partners), OPG has recently announced the a commitment here - Bravo!)
 - support of sabbatical leaves (both universities and industry)
 - teaching (AECL personnel are active at McMaster)
 - support of the Teacher's Course
 - code centre
- Distance learning / courses for industry / on-line reference material (CANTEACH)/ on-line refreshers /professional development....



Steps forward (cont'd)

- Capitalize on Industry's in-house material
- Area Managers can play a leading role in the above
- Define specific roles for both the CNA and the CNS
- Bring COG into the university loop.

- **Costs**

- Sabbaticals are typically 15% of professor's salary + expenses. Perhaps each partner could sponsor one university / industry sabbatical leave.
- Grad student scholarships are about \$15k per year or less + cost of research. In addition, foreign fee differentials are currently about \$8k. Support can be general or targeted to a project, institution, student, etc.
- Undergrad scholarships can be about \$5k per year (flexible).
- Industry can cost out the time for its own staff for teaching, supervising and writing.
- An industrial chair at a university is about \$100k-\$200k per year for 5 years, usually. But it is an efficient way to focus a university program and lever matching grants.
- Distance learning facilities would be \$50k per year, say. Prices are coming down all the time. CD based courses would be very cost effective. Web-based solution can also be very inexpensive.
- It costs almost nothing to be on an Educational Watch: Area Managers can facilitate the collection and review of educational material.

- **Final Message**

- We must address the key issues of
 - Succession planning
 - Client education and training
 - Survival of Nuclear Engineering Educational Programs
- CANTEACH is a key element in addressing these three critical issues.
- Area Managers play an important role in ensuring CANTEACH is successful.
- Industry needs to commit to making a presence in the undergraduate programs. The game is not just about research support. It is also about teaching.

